Efficacy of Fractional CO_2 Laser in Onychomycosis: A Clinical Evaluation

Onychomycosis (OM) is the most common nail infection worldwide. Oral antifungals are traditionally the treatment of choice; however, there is high interest in topical therapy due to minimal risk associated. Prolonged application, limited penetration, and low cure rates are, however, seen. Lasers are Food and Drug Administration (FDA)-approved for temporary clearance or improvement in OM,[1] offering an advantage in patients with comorbidities or those on other medications. Existing literature regarding the type of infection treated, optimum treatment protocols, cure rates, and long-term follow-up is limited.[2] Factors known to influence treatment outcome include nail-plate thickness, extent/type of OM, number of sittings, and concomitant therapy.[3]

Keeping in mind these limitations, it is logical to combine topical and laser therapy. Nail fenestration improves topical drug delivery by three- to fourfold over 42 days making it an optimum pretreatment for OM.[4] Fractional CO_2 laser offers a simple means of creating these fenestrations, even though no definitive protocols or guidelines are available.

We conducted a clinical evaluation of the efficacy of 30 W fractional CO_2 laser in toenails with distal and lateral subungual onychomycosis (DLSO). Patients included either had a lack of response or contraindication to oral antifungals. Diagnosis of OM was confirmed mycologically with direct microscopy (potassium hydroxide [KOH] mount) and fungal culture.

Two patients with seven involved toenails with DLSO were recruited. One of them (19/M) had not responded to systemic therapy over the past 1 year with terbinafine and itraconazole (both administered for 12 weeks each with an intervening period of 3 months). The other (23/F) had developed a fourfold increase in transaminase levels with terbinafine, which normalized over 2 months after stopping the drug. She was reluctant to take oral therapy thereafter. All the nails were KOH positive with *Trichophyton rubrum* growth in culture. Treatment protocol of three incremental laser sessions (microbeam diameter of 0.6 mm, density 166/mm^2) at 4 weekly intervals with daily application of ciclopirox nail lacquer (8%) (CNL) was explained to patients, and written informed consent was taken. The first session (50 mJ), second (100 mJ), and third (150 mJ) were administered at 0.6 mm uniform spacing [Figure 1a]. Patients also agreed to a further 6-months follow-up. All nails were seen to show filling up of fenestrations before the next visit when new fenestrations were created [Figure 1b]. They also showed slow clearing with a distal clearing of the nails by the end of follow-up [Figure 2]; however, complete clinical clearance was not achieved even though direct microscopy and culture were negative at the end of follow-up [Figure 1]. A peculiar yellowish discoloration was noticed after laser therapy, which could either be a result of the cumulative effect of laser (burn) or incomplete removal of nail lacquer due to a fenestrated surface [Figures 1 and 2]. The other side effect was postprocedure deep-seated pain in the great toenail subsequent to 150 mJ energy in the female patient. This pain was poorly responsive to analgesics and lasted about a week.

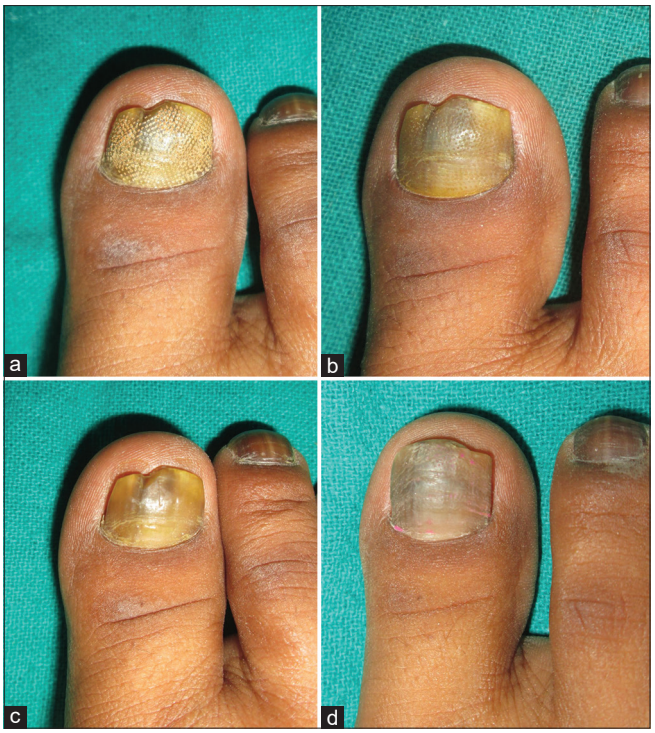

Figure 1: Great toenail treated with fractional CO2 laser to create fenestrations on nail plate (a). Partial filling up of the fenestrations at 2 weeks (b) and at 1 month (c) at which point, the next laser was administered. The treatment end-result and 6 months follow-up with only partial improvement (d)

Our results show that laser with topical therapy in OM might not be as successful as projected or believed. The limitations include preexisting laser systems which are nonoptimal for nails, lack of knowledge regarding the exact chromophore, difficulty in penetration of nail plate, nail plate acting as a fungal reservoir, and lastly, the thermal relaxation time of conidia and hyphae not being known. A fractional laser may be considered as an adjuvant to increase the penetration of topical agents; however, its proposed fungicidal effect is questionable as higher energies required to achieve high enough temperatures for killing fungal elements may not be clinically tolerated and could damage the underlying nail bed, as seen in our female patient. The uniformly spaced fenestrations were visible at all the energies used; hence, it is proposed that

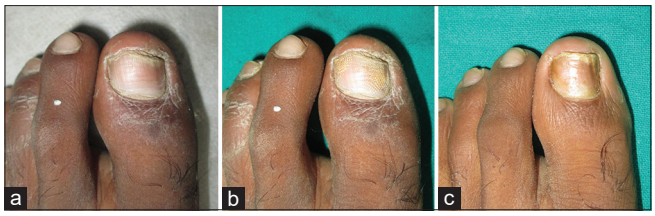

Figure 2: Great toenail with distal lateral subungual onychomycosis (both sides) with surrounding tinea pedis (a). The nail was treated with fractional CO2 laser and ciclopirox nail lacquer as per protocol (b). Tinea pedis was treated with topical oxiconazole cream. Partial improvement at the end of the protocol with thinning of the nail and yellowish discoloration (c)

lower energies could be used to increase penetration of topicals while avoiding discomfort or damage to the nail tissue. Increasing the number of sessions and duration of follow-up could help elicit more definitive results.

To conclude, our study showed evidence of clinical improvement in dermatophyte DLSO; however, clinical cure was not achieved. Since the mechanism of action of lasers in OM is not well elucidated, their reported efficacy and anecdotal results vary greatly. Further studies with a larger number of nails need to be evaluated in controlled trials, keeping in mind the optimum energy delivery to minimize side effects.

Consent statement

The patients have given written informed consent to the publication of the details of the patient in the manuscript.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

Chander Grover, Soni Nanda[1], Shikha Bansal[2]

Department of Dermatology and Venereology, University College of Medical Sciences and Guru Teg Bahadur Hospital, [1]Shine and Smile Clinic, Mayur Vihar, Phase-1, [2]VMMC and Safdarjung Hospital, New Delhi, India

Address for correspondence:
Dr. Chander Grover,
Dermatology and STD, UCMS and GTB Hospital,
New Delhi - 110 095, India.
E-mail: chandergroverkubba@rediffmail.com

References

1. Gupta AK, Simpson F. Newly approved laser systems for onychomycosis. J Am Podiatr Med Assoc 2012;102:428-430.
2. Ma W, Si C, Kasyanju Carrero LM, Liu HF, Yin XF, Liu J, *et al*. Laser treatment for onychomycosis: A systematic review and meta-analysis. Medicine (Baltimore) 2019;98:e17948.
3. Carney C, Cantrell W, Warner J, Elewski B. Treatment of onychomycosis using a submillisecond 1064-nm neodymium: Yttrium-aluminum-garnet laser. J Am Acad Dermatol. 2013;69:578-2.
4. Bhatta AK, Keyal U, Huang X, Zhao JJ. Fractional CO2 laser assisted topical therapy for the treatment of onychomycosis. J Am Acad Dermatol 2016;74:916-23.

Access this article online

Website: www.idoj.in

DOI: 10.4103/idoj.IDOJ_77_21

Quick Response Code

How to cite this article: Grover C, Nanda S, Bansal S. Efficacy of fractional CO_2 laser in onychomycosis: A clinical evaluation. Indian Dermatol Online J 2022;13:133-4.

Received: 09-Feb-2021. **Revised:** 22-Feb-2021.
Accepted: 03-Mar-2021. **Published:** 02-Aug-2021.